was successful in getting large numbers of birds and mammals at various points along the coast. He was especially fortunate in securing an abundant supply of walruses, both bulls and cows, goodly numbers of reindeer and seals, and a smaller number of narwhals.

The writer saw much of the west coast of Greenland between latitude 64° and 78° 45′, at close enough range to study its geographic features to advantage. Stops were made near the parallels of 67°, 69°, 70°, and at many points between 75° 45′ and 77° 45′. At all these points geographical and geological studies were carried on. The eastern coast of America was also seen for a considerable distance, especially from Ellsmere land south to 71° 30′, and most of the coast of the island of Disco. On the Greenland coast many glaciers between 75° 45′ and 77° 45′ were studied in detail, and some determinations of significance concerning glacier motion made. A considerable body of evidence was gathered touching the former extension of the ice cap of Greenland. Determinations were also made at several points concerning recent changes of level of the land.

Rollin D. Salisbury.
University of Chicago, October 4, 1895.

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*ON OYSTERS AND TYPHOID.**

Our motives in undertaking this investigation have been:—

1. Purely scientific—the elucidation of the life conditions of the oyster, both under normal and abnormal environment.

2. Economic or technological—to trace the causes and effects of diseased conditions, with the view of determining what basis exists for the recent 'Oyster and typhoid' scare, (*a*) in the interests of the oyster fisheries, and (*b*) in the interests of the general public.

A. The objects, in detail, we had in view in entering on the investigation were as follows:—

1. To determine the conditions of life and health and growth of the oyster by keeping samples in sea waters of different composition—*e.g.*, it is a matter of discussion amongst practical ostreiculturists as to what specific gravity or salinity of water, and what amount of lime are best for the due proportionate growth of both shell and body.

2. To determine the effect of feeding oysters on various substances—both natural food, such as Diatoms, and artificial food, such as oatmeal. Here, again, there is a want of agreement at present as to the benefit or otherwise of feeding oysters in captivity.

3. To determine the effect of adding various impurities to the water in which the oysters are grown, and especially the effect of sewage in various quantities. It is notorious that oysters are frequently grown or laid down for fattening purposes in water which is more or less contaminated by sewage, but it is still an open question as to the resulting effect upon the oyster.

4. To determine whether oysters not infected with a pathogenic organism, but grown under insanitary conditions, have a deleterious effect when used as food by animals.

5. To determine the effect upon the oyster of infection with typhoid, both naturally—*i.e.*, by feeding with sewage water containing typhoid stools, and artificially—*i.e.*, by feeding on a culture in broth of the typhoid organism.

6. To determine the fate of the typhoid bacillus in the oyster—whether it is confined to the alimentary canal, and whether it increases in any special part or gives rise

*An experimental inquiry into the effect upon the oyster of various external conditions including pathogenic organisms. A paper presented before Section D. at the Ipswich Meeting of the British Association, by R. W. Boyce, Professor of Pathology in University College, Liverpool; and W. A. Herdman. Professor of Zoölogy in University College, Liverpool,

to any diseased conditions; how long it remains in the alimentary canal; whether it remains and grows in the pallial cavity, on the surface of the mantle and branchial folds; and whether it produces any altered condition of these parts that can be recognized by the eye on opening the oyster.

7. To determine whether an oyster can free its alimentary canal and pallial cavity from the typhoid organism when placed in a stream of clean sea water; and, if so, how long would be required, under average conditions, to render infected oysters practically harmless.

B. The methods which we employed in attaining these objects were as follows:—

1. Observations upon oysters laid down in the sea, at Port Erin—

(*a*) Sunk in 5 fathoms in the bay, in pure water.

(*b*) Deposited in shore pool, but in clean water.

(*c*) Laid down in three different spots in more or less close proximity to the main drain pipe, opening into the sea below low-water mark.

These were to ascertain differences of fattening, condition, mortality, and the acquisition of deleterious properties as the result of sewage contamination.

2. Observations upon oysters subjected to various abnormal conditions in the laboratory.*

(*a*) A series of oysters placed in sea water and allowed to stagnate, in order to determine effect of non-aëration.

(*b*) Similar series in water kept periodically aërated.

(*c*) A series placed in sea water to which a given quantity of fresh (tap) water was added daily, to determine effect of reduction of salinity.

* The oysters were kept in basins in cool rooms of constant temperature, shaded from the sun, both at the Port Erin Biological Station and also in the Pathological and Zoölogical Laboratories at University College, Liverpool.

(*d*) A series of oysters weighed approximately, and fed upon the following substances, viz.:—

(1) Oatmeal.

(2) Flour.

(3) Sugar.

(4) Broth.

(5) Living Protophyta (Diatoms, Desmids, Algæ).

(6) Living Protozoa (Infusoria, etc.).

(7) Earth.

In this series of experiments the oysters were fed every morning and the water aërated, but not changed (evaporation was compensated for by the addition of a little tap water as required). The oysters were weighed from time to time, and observations made upon the apparently harmful or beneficial effects of the above methods of treatment.

(*e*) A series of oysters placed in sea water to which was added daily—

(1) Healthy fæcal matter.

(2) Typhoid fæcal matter.

(3) Pure cultivations of the typhoid bacillus.

The oysters were carefully examined to determine their condition, with special reference to condition of branchia, alimentary canal, adductor muscle, and viscera generally. The contents of the rectum, as well as the water in the pallial cavity, were subjected to bacteriological analysis to determine the number of micro-organisms present, as well as the identity of the typhoid or other pathogenic organisms.

C. The following is a summary of the results obtained so far:—

We consider that these results are based upon tentative experiments, and serve only to indicate further any definite lines of research. They must not be regarded as conclusive. We feel strongly that all the experiments must be repeated and extended in several directions.

Our experiments demonstrate:—

I. The beneficial effects of aëration—

(*a*) By the addition of air only;

(*b*) By change of water;

pointing to the conclusion that the laying down of oysters in localities where there is a good change of water, by tidal current or otherwise, should be beneficial.

II. The diverse results obtained by feeding upon various substances, amongst which the following may be noted. The exceedingly harmful action of sugar, which caused the oysters to decrease in weight and die; whilst the other substances detailed above enabled them to maintain their weight or increase. The oysters thrive best upon the living Protophyta and Protozoa. Those fed upon oatmeal and flour after a time sickened and eventually died.

III. The deleterious effects of stagnation, owing to the collection of excretory products, growth of micro-organisms, and formation of scums upon the surface of the water.

IV. The toleration of sewage, etc. It was found that oysters could, up to a certain point, render clear sewage-contaminated water, and that they could live for a prolonged period in water rendered completely opaque by the addition of fæcal matter; that the fæcal matter obtained from cases of typhoid was more inimical than that obtained from healthy subjects; and that there was considerable toleration to peptonised broth.

V. The infection of the oyster by the micro-organisms. The results of the bacteriological examination of the water of the pallial cavity of the oyster, and of the contents of the rectum, showed that in the cases of those laid down in the open water of the bay the colonies present were especially small in number, whilst in those laid down in proximity to the drain pipe the number was enormous (*e. g.*, 17,000 as against 10 in the former case). It was found that more organisms were present in the pallial cavity than in the rectum. In the case of the oysters grown in water infected with the *Bacillus typhosus*, it was found that there was no apparent increase of the organisms, but that they could be identified in cultures taken from the water of the pallial cavity and rectum fourteen days after infection.

It is found that the typhoid bacillus will not flourish in clean sea water, and our experiments seem to show so far that it decreases in numbers in its passage along the alimentary canal of the oyster. It would seem possible, therefore, that by methods similar to those employed in the 'Bassins de dégorgement' of the French ostreiculturist, where the oysters are carefully subjected to a natural process of cleaning, oysters previously contaminated with sewage could be freed of pathogenic organisms or their products without spoiling the oyster for the market.

It need scarcely be pointed out that if it becomes possible thus to cleanse infected or suspected oysters by a simple mode of treatment which will render them innocuous, a great boon will have been conferred upon both the oyster trade and the oyster-consuming public.

We desire to acknowledge the kind help of Mr. W. I. Beaumont in making some of the observations at Port Erin, and of Mr. Andrew Scott at Liverpool.

ADDRESS OF THE PRESIDENT, SIR DOUGLAS GALTON, BEFORE THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (II.).

The earliest Reports of the Association which bear on the biological sciences were those relating to botany. In 1831 the controversy was yet unsettled between the advantages of the Linnæan, or Artificial system, as contrasted with the Natural system of classification. Histology, morphology, and physiological botany, even if born, were